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Livestock and Riparian-Fishery Interactions: What Are the Facts?

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Introduction

The riparian environment has become a key consideration in the planning and management of the public lands. This highly productive habitat receives many uses, some of which conflict with one another. Because there are conflicts that need immediate attention, range and fishery managers are making complicated, hurried decisions, often without the benefit of adequate knowledge or experience. In addition, interpretations emerging from riparian studies are often confusing and contradictory, inhibiting the manager's decision-making abilities.

Leopold (1974) stated that fish and wildlife habitat in western rangeland has experienced and is experiencing a steady deterioration under livestock grazing. The same year, Heady et al. (1974) stated that livestock grazing is being managed and integrated with other uses of federal lands and that there is no evidence that well-managed grazing of domestic livestock is incompatible with a high quality environment. Behnke and Zarn (1976), on the other hand, reported that degradation of streambanks by livestock is one of the principal factors contributing to the decline of native trout in the West. Two years later, Hayes (1978) concluded that, during spring runoff, streambank degradation occurred more often and to a greater extent along ungrazed streambanks than along grazed streambanks. Busby (1979) stated that range conditions today are far better than the denuded, deteriorated rangelands that existed in the early 1900s. A year later, Platts (1979) agreed with this interpretation, but pointed out that the improvement was based mainly on data collected from drier portions of the rangeland and did not take into account the still deteriorated condition of riparian areas. Kimbal and Savage (1977) reported that proper grazing management will restore degraded riparian-stream habitats, and Duff (1977), a year later, stated that trout numbers increased dramatically and the condition of the riparian habitat immediately improved when grazing was eliminated. Holechek (1981) in a recent issue of the *Journal of Range Management* went even further. He stated that livestock grazing controlled by the use of scientific principles is compatible with other public rangeland resources, and may be used for the enhancement of these resources.

Land managers are having a tough enough time trying to properly manage the riparian-stream habitats without the literature confusing their thinking. This report attempts to evaluate past findings and to place the facts in better perspective. Many articles in the literature discuss the effects of livestock grazing on riparian-fishery habitats, but most are either intuitively developed or are state-of-the-art reports that do not include actual data for analysis. Examples are Armour 1977, Bakke 1977, Behnke and Zarn 1976, Meehan and Platts 1978, Miller 1972, Platts 1978, 1981, and Platts and Martin 1980. These types of articles were ignored in this report; only those reports that provided actual data with interpretation were considered in determining the facts. Study evaluations were based on study design,

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sample size, statistical reliability and whether the area provided an unbiased place to do research.

Findings of the Fishery Profession

Effects on Fish Populations

One detailed research report was on Rock Creek, Montana, where Gunderson (1968) reported that brown trout (*Salmo trutta* [Linnaeus]) biomass was 31 percent greater per unit area in an ungrazed stream section than in an adjacent grazed section. Marcuson (1977) in a follow-up study, found brown trout biomass was 3.4 times greater per unit area in the ungrazed versus the grazed section. While the authors' conclusions may be true, there is the dangerous possibility that even if cattle had never grazed the area, one of the reaches could have contained 3.4 times more trout biomass than the other. Also, the stream had previously experienced a major flood that resulted in the grazed section being channelized and cleared of vegetation by the U.S. Army Corps of Engineers. The grazed section had also been burned over in the 1930s while the nongrazed area was not. Their conclusions concerning grazing effects, therefore, are difficult to defend.

Storch (1979) found that, after 10 years of rest inside an exclosure (an area rested from grazing), game fish made up 77 percent of the fish population on Camp Creek, Oregon, but only 24 percent of the population in the grazed areas outside the exclosure. Storch failed, however, to show that the areas were comparable and that the differences reported did not occur naturally. His conclusions, therefore, are also hard to defend.

Van Velson (1979) blames the past heavy livestock grazing in the Otter Creek, Nebraska, drainage for the elimination of trout spawning runs in the stream. The author stated that large spawning runs composed of sizable trout entered Otter Creek prior to grazing, and that, after grazing was begun, runs soon became insignificant. Later, when livestock was excluded from the upper 2 miles (3.2 km) of stream, rainbow trout spawning runs again developed. A confusing factor is that, with the exclusion of the livestock grazing, the Nebraska Game and Parks Commission initiated a rainbow trout fingerling stocking program. Furthermore, no fish population data were presented prior to the exclusion of grazing for valid comparisons. Therefore, it is difficult to distinguish the benefits derived from the fish-stocking program from those derived from reduced livestock grazing. The circumstantial evidence, however, infers that reduced livestock grazing was the main factor responsible for increasing trout populations.

Starostka (1979), studying Sevenmile Creek, Utah, found that trout numbers per unit area in an ungrazed 2-mile (3.2 km) section of stream were about the same as in adjacent grazed sections. The exclosure was constructed in 1961, but by 1970 was no longer functioning and the area had been returned to grazing. In 1974, the exclosures were refurbished and grazing was eliminated, but no changes in fish populations could be detected. This study contains the same problem that most studies contain; there were no pregrazing data, therefore bias can cloud the interpretations.

Platts (In press a) in his Horton Creek, Idaho, studies found that fish density in a lightly grazed or nongrazed meadow stream section was 10.9 times higher than the density in an adjacent heavily grazed stream section. The grazed portion of the meadow had been heavily grazed by sheep for 80 years under a continuous system, while the lightly grazed or nongrazed meadow had been rested during most of this time. Platts assumed that, prior to livestock grazing, the two stream reaches were similar and, therefore, fell into the same trap that occurred in most of the other fishery studies. Platts' conclusions, although they may be correct, are based on circumstantial evidence and are therefore suspect.

Platts (In press b), in studying a sheep rest rotation system in Frenchman Creek, Idaho, concluded that sheep grazing was having no detrimental effect on the fish population. Again, Platts had no pregrazing information to go on, but based his conclusions on results obtained by comparing a grazed section of Frenchman Creek with a presently ungrazed section (exclosure). The fact that the fish population in the area grazed by sheep was in good condition led him to his conclusion.

Platts (In press c), on the South Fork Salmon River, Idaho, studied a three-pasture, rest-rotation cattle grazing system initiated in 1979 in a previously ungrazed watershed. He concluded that the first cycle of the cattle rest-rotation system had no effect on the fish population. This conclusion was sound because the study design and methodology was sound. Pregrazing information was obtained and he used two controls to check the results of the treatment findings. As this study progresses through additional grazing cycles, changes in the fish population may take place.

Chapman and Knudsen (1980) compared pairs of grazed and ungrazed stream sections in the Puget Sound area of Washington and found that although livestock-altered reaches contained less total cutthroat trout biomass, young-of-the-year trout biomass was higher. The field crews used a visual analysis of the channel to determine if the channel had been altered by livestock or was still in a natural state. This, plus the fact that conditions prior to any supposed alteration are unknown, means that the results might have been the same without grazing.

Duff (1977) studied Big Creek, Utah, and found after three years that trout numbers within an ungrazed exclosure were 3.6 times greater than those in a downstream grazed area. However, an upstream grazed area that was influenced by beaver dams had 1.5 times as many trout as the ungrazed exclosure. Again, as in most studies, the author gives no supporting data to establish whether the areas are comparable. Also, the addition of 17 in-stream habitat structures inside and outside the exclosure in 1970, an additional 26 structures built solely within the exclosure in 1971, and the annual fish-stocking program could bias the study conclusions relating to fish populations.

Keller et al. (1979) studied the effects of exclosures closed to cattle grazing on Summit Creek, Idaho. Two miles of the stream below the headwater spring source were fenced to exclude cattle, and Keller reported a remarkable recovery in aquatic habitat conditions. A high variation in fish population estimates precluded statistically valid appraisals of what happened to the fish population. Also, the closer the fish population is to the spring source, the higher the population density; this bias could cause confusion. Again, the sites selected for comparison had no pretreatment information to determine whether they were truly comparable.

Effects on Riparian-Aquatic Habitat

All but one of the 20 studies conducted by the fishery specialists listed in Table 1 concluded that riparian-stream habitats had been degraded by livestock grazing. The same number reported that such habitats improved when grazing was prohibited. Platts (In press a) was the only author who found that conditions improved with grazing and this was on a well-managed sheep allotment using a rest-rotation system with effective herding that protected the riparian areas. Duff (1977) found that riparian vegetation biomass increased 63 percent in a Big Creek, Utah, exclosure after four years of rest. Marcuson (1977) found that ungrazed sections of Rock Creek, Montana, had 82 percent more vegetative cover per unit of stream than grazed areas. Van Velson (1979) found remarkable increases in the amount of riparian vegetation adjacent to Otter Creek, Nebraska, once cattle grazing was eliminated. Platts (In press c) found that an ungrazed stream reach on Horton Creek was only one-fourth as wide and five times as deep as the adjacent reach on a grazed section. Storch (1979) found in Camp Creek, Oregon, that 10 years of rest from grazing stabilized the streambanks and dramatically increased the shade over the stream. Even though most of these studies have much the same biases as

Table 1. Fishery or fishery related authors' findings of riparian-stream habitat and fish population conditions influenced by livestock grazing.

	Riparian condition			Fish populations			Soundness of conclusions		
Author	Improved	No change	Degraded	Increased	No change	Decreased	Good	Fair	Poor
Berry and Goebel (1978)			X			X		X	
Chapman and Knudsen (1980)			X			X		X	
Clair and Storch (1977)			X			X			X
Crispin (Unpublished)			X			X			X
Dahlem(1979)			X	—	—	—		X	
Duff (1977)			X			X			X
Gunderson (1968)			X			X			X
Keller et al. (1979)			X			X			X
Kennedy (1977)			X			X			X
Lorz (1974)			X			X		X	
Marcuson (1977)			X			X			X
Platts (In press a)			X			X		X	
Platts (In press c)	X				X			X	
Platts (In press b)			X		X		X		
Platts (1978)			X			X			X
Starostka (1979)			X		X				X
Storch (1979)			X			X			X
Van Velson (1979)			X			X		X	
Wineger (1977)			X	—	—	—		X	
Winget and Reichert (1976)			X			X		X	

discussed earlier, there is concensus among authors that improper livestock grazing degrades the riparian-aquatic habitat.

Findings of the Range Profession

Range and watershed specialists have concentrated their studies on the upland part of the watershed and few studies center on riparian-stream systems. Most range specialists agree that the poorest rangeland conditions occurred between 1885 and 1935 and that they have been improving since that time (Busby 1979). A few range specialists feel that serious and extensive environmental degradation has taken place and is continuing to take place (Meiners 1974). Specialists with either viewpoint rely mainly on intuitive thinking rather than actual data analysis to reach their conclusions.

Sediment Effects

Busby and Gifford (unpublished) and Branson and Owen (1970) found that grazing may be altering water quality by affecting the hydrologic conditions within a given watershed (Table 2). Wood and Blackburn (1981), working in the rolling plains of Texas, found that sediment production in grazed shrub canopy areas was the same as in ungrazed areas. Lusby (1970), studying the effects of grazing on watershed hydrology in Colorado, found that ungrazed watersheds produced only 71 to 76 percent as much sediment as did grazed watersheds. These studies were all well designed and their conclusions sound. They show that the likelihood of livestock grazing altering a watershed and increasing the amount of sediment deposition in streams depends on such things as landform, grazing strategy, climate, condition of the vegetation, and grazing intensity.

Table 2. Range and watershed authors's findings on riparian-stream habitat conditions under grazed conditions.

	Riparian condition			Stream condition			Soundness of conclusions		
Author	Improved	No change	Degraded	Improved	No change	Degraded	Good	Fair	Poor
Buckhouse et al. (1977)[a]		—			X		X		
Buckhouse et al. (1981)		—			X			X	
Busby and Gifford (Unpublished)		—				X	X		
Gifford and Hawkins (1976)[a]		X		—	—	—	X		
Hayes (1978)		—		X					X
Kimbal and Savage (1977)	X			X					X
Lusby (1970[a]		—				X	X		
USDI-BLM (1974)			X			X			X
Wood and Blackburn (1981)[a]		—			X		X		

[a]A study that presents watershed data interpreted by William S. Platts as to effects of livestock grazing on riparian-stream systems.

Riparian-Aquatic Habitat Effects

Hayes (1978) studied a series of high elevation meadows and their associated streams in central Idaho. Ungrazed meadows were compared with meadows that were being grazed by cattle under a three-pasture, rest-rotation system. After only one field season of observation, Hayes reported that rest-rotation grazing by cattle did not significantly alter channel movement and that soil erosion on the ungrazed streambanks was significantly greater than the erosion on the grazed streambanks. Hayes did attribute some bank erosion to livestock during the vegetative growing season.

Hayes' conclusion that streambank erosion was greater on ungrazed watersheds than on grazed watersheds is biased because of improper study design. Hayes selected a study stream for the ungrazed meadow sites that naturally had less stable streambanks, greater stream power, four times greater channel gradient, higher stream velocities, larger channel substrate, and greater distance from the stream bottom to the top of the bank than the streams selected to represent grazed conditions. The grazed sites were also higher in elevation. The sites were in no way comparable and so the conclusions of the study cannot be accepted.

Kimbal and Savage (1977) suggested that in time proper grazing management will restore degraded riparian habitats. Under a reduced cattle stocking program, with watershed revegetation, a stream rehabilitation program, and a rest-rotation grazing system, these authors showed that the standing crop of fish in the Diamond Fork, Utah, study site increased 400 percent over the 10-year range improvement program. Armour (Unpublished) in a critique of the Kimbal and Savage Diamond Fork Aquatic study demonstrated, however, that their study design was technically deficient and that there was no way in which to determine whether the stated recovery actually happened. Their conclusions, therefore, cannot be accepted as fact.

Buckhouse et al. (1981) studied different grazing strategies on Meadow Creek, Oregon, and discovered that the relative stability of Meadow Creek was not significantly changed ($P>0.10$) after two years of cattle grazing. Although they found that the grazed streambanks experienced more sloughing of cutbanks (average of 15 cm per year) than the ungrazed banks (average of 9.5 cm per year), they concluded that the difference between the means was not significant. The study design was solid and the sampling data were of high caliber, but the confounding factors are that the Meadow Creek riparian areas have been grazed for the past 100 years, logging has eliminated 50 percent of the riparian overstory, and, at one time, logs were driven down the stream during high flows with the aid of splash dams. Furthermore, a railroad and road were constructed along some areas of the stream. This stream, therefore, may not lend itself to a study of this type.

Conclusions

About 85 percent of the fishery-range studies found in the literature, with a study design and data base for interpretations, concluded that livestock grazing degraded stream-riparian environments. However, it is possible that many of these study sites were chosen in the most degraded areas and do not represent the overall range condition. Also, the studies do not identify whether the grazing strategy and intensity of use being studied were being properly or improperly managed. This

classification presents a problem because "proper grazing" is in the mind of the beholder and changes from person to person and from discipline to discipline.

A bias exists in most of the livestock-fishery interaction studies because of poor study design, poor data collection, or erroneous interpretations, and seldom have authors known the exact condition of their study area prior to the grazed conditions. Also, those studies confounded by stream improvement structures, other land uses, or fish-stocking programs may have just as much bias. Regardless of the biases in the studies, when the findings of all studies are considered together, there is evidence indicating that past livestock grazing has degraded riparian-stream habitats and decreased fish populations.

The future calls for range and fishery professionals to work closely together to build solidly designed studies that will continue the management goal of building good compatibility between fisheries and livestock grazing.

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